

WHAT IS CLAIMED IS:

1. A method for shimming a magnetic field of a magnet in a volume of interest, wherein the magnet is configured to utilize, for shimming, ferromagnetic pellets positioned in a nonmagnetic holder having a predetermined number of pellet holes, said method comprising:

measuring the magnetic field of a magnet in a plurality of locations within the volume of interest;

determining a nominal passive shimming mass to compensate the measured magnetic field to approximate a desired magnetic field within the volume of interest; and

placing a combination of ferromagnetic pellets from a selection of full strength pellets, nearly full strength pellets, and low strength pellets in the pellet holes to approximate the nominal passive shimming mass.

2. The method of Claim 1 wherein the nearly full strength pellets are nominally about 95% of the strength of the full strength pellets and the low strength pellets are nominally about 6% of the strength of the full strength pellets.

3. A method in accordance with Claim 1 wherein said placing a combination of ferromagnetic pellets from a selection of full strength, nearly full strength, and low strength pellets in the pellet holes further comprises placing the holder into mounting hardware in an apparatus to effect the shimming of the magnetic field.

4. A method in accordance with Claim 3 further comprising:

remeasuring the magnetic field of the magnet in a plurality of locations within the volume of interest to determine a residual deviation from the desired magnetic field;

determining a nominal shimming mass change to compensate for the residual deviation; and

adjusting the combination of pellets in the holder in accordance with an approximation of the nominal shimming mass change.

5. A method in accordance with Claim 4 wherein said full strength pellets have a mean strength and standard deviation about said full strength, said nearly full strength pellets have a mean strength and standard deviation about said nearly full strength, and said low strength pellets have a mean strength and standard deviation about said low strength,

and wherein said adjusting the combination of pellets in the holder in accordance with an approximation of the determined nominal shimming mass change comprises minimizing $|\mu - \Delta M| + \alpha\sigma$, where:

μ is a mean actual mass change resulting from the adjusted combination of pellets,

ΔM is the nominal shimming mass change,

α is a weighting factor, and

σ is a standard deviation of the actual mean mass change.

6. A method in accordance with Claim 4 wherein said remeasuring the magnetic field, determining the nominal shimming mass change, and adjusting the combination of pellets are performed more than once to further reduce a measure of the residual deviation from the desired magnetic field.

7. A method in accordance with Claim 6 wherein said adjusting the combination of pellets in the holder in accordance with an approximation of the determined nominal shimming mass change comprises minimizing $|\mu - \Delta M| + \alpha\sigma$, where:

μ is a mean actual mass change resulting from the adjusted combination of pellets,

ΔM is the nominal shimming mass change,

α is a weighting factor, and

σ is a standard deviation of the actual mean mass change.

8. A shimming set having exactly three strengths of ferromagnetic pellets including full strength pellets, nearly full strength pellets, and low strength pellets, a nonmagnetic holder configured to hold a fixed number of said pellets, and a pellet combination selector aid to facilitate selection of a combination of said pellets not exceeding said fixed number of pellets and which approximates a desired total mass.

9. A shimming set in accordance with Claim 8 wherein said pellet combination selection means comprises machine readable instructions configured to instruct a computer to select said combination of said pellets not exceeding said fixed number in accordance with said desired total mass.

10. A shimming set in accordance with Claim 8 wherein said pellet combination selection means comprises a table listing one or more combinations of pellets corresponding to a plurality of strengths, and wherein said strengths are sorted in numerical order.

11. A shimming set in accordance with Claim 8 wherein the nearly full strength pellets are nominally about 95% of the strength of the full strength pellets and the low strength pellets are nominally about 6% of the strength of the full strength pellets.

12. A method for shimming, within an imaging volume, a magnetic field of a magnet of an MRI apparatus, wherein the magnet is configured to utilize, for shimming, ferromagnetic pellets positioned in a nonmagnetic holder having a predetermined number of pellet holes, said method comprising:

measuring the magnetic field of the magnet in a plurality of locations within the imaging volume;

determining a nominal passive shimming mass to compensate the measured magnetic field to approximate a desired magnetic field within the imaging volume; and

placing a combination of ferromagnetic pellets from a selection of full strength pellets, nearly full strength pellets, and low strength pellets in the pellet holes to approximate the nominal passive shimming mass.

13. The method of Claim 12 wherein the nearly full strength pellets are nominally about 95% of the strength of the full strength pellets and the low strength pellets are nominally about 6% of the strength of the full strength pellets.

14. A method in accordance with Claim 12 wherein said placing a combination of ferromagnetic pellets from a selection of full strength, nearly full strength, and low strength pellets in the pellet holes further comprises placing the holder into a position to effect the shimming of the magnetic field.

15. A method in accordance with Claim 14 further comprising:

remeasuring the magnetic field of the magnet in a plurality of locations within the imaging volume to determine a residual deviation from the desired magnetic field;

determining a nominal shimming mass change required to compensate for the residual deviation; and

adjusting the combination of pellets in the holder in accordance with an approximation of the nominal shimming mass change.

16. A method in accordance with Claim 15 wherein said full strength pellets have a mean strength and standard deviation about said full strength, said nearly full strength pellets have a mean strength and standard deviation about said

nearly full strength, and said low strength pellets have a mean strength and standard deviation about said low strength,

and wherein said adjusting the combination of pellets in the holder in accordance with an approximation of the determined nominal shimming mass change comprises minimizing $|\mu - \Delta M| + \alpha\sigma$, where:

μ is a mean actual mass change resulting from the adjusted combination of pellets,

ΔM is the nominal shimming mass change,

α is a weighting factor, and

σ is a standard deviation of the actual mean mass change.

17. A method in accordance with Claim 15 wherein said remeasuring the magnetic field, determining the nominal shimming mass change, and adjusting the combination of pellets are performed more than once to further reduce a measure of the residual deviation from the desired magnetic field.

18. A method in accordance with Claim 17 wherein said adjusting the combination of pellets in the holder in accordance with an approximation of the determined nominal shimming mass change comprises

comprises minimizing $|\mu - \Delta M| + \alpha\sigma$, where:

μ is a mean actual mass change resulting from the adjusted combination of pellets,

ΔM is the nominal shimming mass change,

α is a weighting factor, and

σ is a standard deviation of the actual mean mass change.

19. An MRI apparatus comprising a superconducting magnet having a magnetic field shimmed to an approximation of a uniform magnetic field within a volume of interest utilizing exactly three different strengths of ferromagnetic pellets.

20. A kit of sintered shimming pellets consisting of a plurality of pellets having exactly three different strengths, wherein said strengths are full strength, nearly full strength, and low strength, wherein said different strength pellets are of equal size, and pellets of different strengths comprise different percentage mixtures of iron powder and plastic powder.